



U.S. Department
of Transportation
**Federal Highway
Administration**

400 Seventh St., S.W.
Washington, D.C. 20590

December 21, 2004

In Reply Refer To: HSA-10/SS-126

Mr. Mark W. McGinnis
Northwest Pipe Company
Traffic Systems Group, Suite 1800
200 SW. Market Street
Portland, Oregon 97201

Dear Mr. McGinnis:

Thank you for your letter of October 27 requesting Federal Highway Administration (FHWA) acceptance of your company's perforated square steel tubes as breakaway sign supports for use on the National Highway System (NHS). Accompanying your letter was a report from the Texas Transportation Institute and videos of the crash tests. You requested that we find your company's soil-mounted posts acceptable for use on the NHS under the provisions of National Cooperative Highway Research Program (NCHRP) Report 350 "Recommended Procedures for the Safety Performance Evaluation of Highway Features."

Introduction

Testing of the supports was in compliance with the guidelines contained in the NCHRP Report 350, Recommended Procedures for the Safety Performance Evaluation of Highway Features. Requirements for breakaway supports are those in the American Association of State Highway and Transportation Officials' (AASHTO) Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals.

Testing

A combination of full-scale automobile and bogie pendulum testing was conducted on your company's devices. The mass of the test vehicle was 866 kg, and the mass of the pendulum bogie was 820 kg. Although pendulum tests are not routinely accepted for use with base-bending/yielding supports, the crash behavior and post-impact vehicle trajectory is fairly well known for perforated square steel posts. The FHWA concurred in the use of pendulum testing to verify performance for your company's posts as a new manufacturer.

All supports tested were ASTM A653, G90, Structural Quality Grade 50 steel perforated square steel tubes inserted into an anchor that was one size larger than the sign post. The tests are summarized below. The complete devices as tested are shown in the Enclosures.



400001-NWP1 Full scale automobile test. Dual post. Two 2 ½ inch 12-gage posts inserted 10 inches into 36 inch long anchors, spaced 36 inches on center. The posts were secured to the anchors with 3/8 inch corner bolts. A 48 x 72 inch by 5/8 inch thick plywood sign panel was attached to the posts with 0.375 inch, 3.5 inch long bolts. The bottom of the sign was mounted 84 inches above the ground. The tops of the anchors were one inch above the ground. Upon impact the posts bent and the sign impacted the roof. The anchors and posts pulled out of the weak soil and the sign panel separated from the posts. Windshield damage was minimal to moderate, with cracking in both layers of glass. No holes were made through all three layers of the windshield.

400001-NWP5 Pendulum test. Single post. One 2 ½ inch 12-gage post was inserted 10 inches into a 36-inch long, 3x3 inch square 7-gage anchor embedded 35 inches into Report 350 Standard soil. A 36 x 43 inch by 5/8 inch thick plywood sign panel was attached to the post at a height of 7 feet to the bottom. The posts were secured to the anchors with 3/8 inch corner bolts.

400001-NWP6 Pendulum test. Single Post. Same as above except the installation was in weak soil, and the anchor was winged.

Test #	NCHRP 350	Speed	Version	Article	Occup. Speed	Delta V
1	3-61, Weak	99.2 kmh	Dual 2 inch	12 ga Gr 50	3.6 m/s	3.6 m/s
2	3-61, Standard	35 kmh	Single 2.5 in	12 ga Gr 50	None	3.3 m/s
3	3-61, Weak	35 kmh	Single 2.5 in	With anchor	None	2.4 m/s

NCHRP 350: Report 350 test designation, and soil type.

Version: Number of posts truck and size of each

Article: Thickness of post and grade of steel

Occup. Speed: Occupant Impact Speed: Speed at which a theoretical front seat occupant will contact the windshield. In meters per second.

Delta V: Speed change of the test vehicle. In meters per second.

Findings

Damage in test 1 was limited to cracking of the windshield and bumper damage. Sign trajectory in all 3 tests was satisfactory. Velocity changes were all within acceptable limits, and the only stub remaining was in test 2 where the post was pulled partially up out of the ground. The results of testing met the FHWA requirements and, therefore, the devices described above and shown in the enclosed drawings for reference are acceptable for use as Test Level 3 devices on the NHS under the range of conditions tested, when proposed by a State. The attached table, "Acceptable Uses of Perforated Square Steel Tube Sign Posts, Per Request of Northwest Pipe Company," delineates the sizes, foundation conditions, and number of supports that may be used.

Please note the following standard provisions that apply to the FHWA letters of acceptance:

- Our acceptance is limited to the crashworthiness characteristics of the devices and does not cover their structural features, nor conformity with the Manual on Uniform Traffic Control Devices.
- Any changes that may adversely influence the crashworthiness of the device will require a new acceptance letter.
- Should the FHWA discover that the qualification testing was flawed, that in-service performance reveals unacceptable safety problems, or that the device being marketed is significantly different from the version that was crash tested, it reserves the right to modify or revoke its acceptance.
- You will be expected to supply potential users with sufficient information on design and installation requirements to ensure proper performance.
- You will be expected to certify to potential users that the hardware furnished has essentially the same chemistry, mechanical properties, and geometry as that submitted for acceptance, and that they will meet the crashworthiness requirements of the FHWA and the NCHRP Report 350.
- To prevent misunderstanding by others, this letter of acceptance, designated as number SS-126 shall not be reproduced except in full. As this letter and the supporting documentation which support it become public information, it will be available for inspection at our office by interested parties.
- This acceptance letter shall not be construed as authorization or consent by the FHWA to use, manufacture, or sell any patented device for which the applicant is not the patent holder. The acceptance letter is limited to the crashworthiness characteristics of the candidate device, and the FHWA is neither prepared nor required to become involved in issues concerning patent law. Patent issues, if any, are to be resolved by the applicant.

Sincerely yours,

/Original Signed by/

John R. Baxter, P.E.
Director, Office of Safety Design
Office of Safety

Enclosures

FHWA:HSA-10:NArtimovich:tb:x61331:12/9/04
File: h://directory folder/artimovich/WZ126-NWPipe
cc: HSA-10 (Reader, HSA-1; Chron File, HSA-10;

N.Artimovich, HSA-10)

Acceptable Uses of Perforated Square Steel Tube Sign Posts, Per request of Northwest Pipe Company

Posts are fabricated from ASTM A653 SQ Grade 50, Modified to "Grade 55", certified to 414 MPa min yield¹

Post Size mm x mm (in x in)	One Post in a 2.1-m Path								Two Posts in a 2.1-m Path							
	Standard Soil				Weak Soil				Standard Soil				Weak Soil			
	With Anchor Base ⁽²⁾		Direct Burial		With Anchor Base ⁽²⁾		Direct Burial		With Anchor Base ⁽²⁾		Direct Burial		With Anchor Base ⁽²⁾		Direct Burial	
	2.10 mm ⁽³⁾	2.66 mm ⁽³⁾	2.10 mm ⁽³⁾	2.66 mm ⁽³⁾	2.10 mm ⁽³⁾	2.66 mm ⁽³⁾	2.10 mm ⁽³⁾	2.66 mm ⁽³⁾	2.10 mm ⁽³⁾	2.66 mm ⁽³⁾	2.10 mm ⁽³⁾	2.66 mm ⁽³⁾	2.10 mm ⁽³⁾	2.66 mm ⁽³⁾	2.10 mm ⁽³⁾	2.66 mm ⁽³⁾
63.5x63.5 (2.5x2.5)	—	yes	—	—	—	yes	—	—	—	—	—	—	—	—	—	—
57.2x57.2 (2.25x2.25)*	yes	yes	yes	yes	yes	yes	yes	yes	—	—	—	—	—	—	—	—
50.8x50.8 (2.0x2.0)*	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	—	yes	yes	yes	—
44.5x44.5 (1.75x1.75)*	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
38.1x38.1 (1.5x1.5)*	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes

1. 413.69 MPa = 60,000 psi. The ultimate tensile strength of the steel coil used to produce the tube should not exceed 550 MPa (79,800 psi) or have an elongation measured over 50 mm (2 inches) greater than 20%.

2. The anchor base may or may not have a strengthening sleeve at groundline. The anchor bases shall be sized to fit closely around the post. For 63.5x63.5 posts of both wall thicknesses and 57.2x57.2x2.66 posts the anchor bases shall be made of steel comparable to that of the posts and have wall thicknesses equal 4.55 mm (7 ga) or greater. For 57.2x57.2x2.10 posts and all 55.6x55.6 and smaller posts the anchor bases shall be made of steel comparable to that of the posts and have wall thicknesses equal 2.66 mm (12 ga) or greater.

3. The dimension shown is the wall thickness of the post. 2.10 mm = 14 ga and 2.66 mm = 12 ga.

* These sizes are the only ones expected to be produced with a 14 ga wall thickness. The 38.1 x 38.1 mm post size is acceptable because it is smaller, and likely to be crashworthy.

ENCLOSURE

Acceptable Uses of Perforated Square Steel Tube Sign Posts, Per request of Northwest Pipe Company

Posts are fabricated from ASTM A653 SQ Grade 50, Modified to "Grade 55", certified to 414 MPa min yield¹

Post Size mm x mm (in x in)	One Post in a 2.1-m Path						Two Posts in a 2.1-m Path					
	Standard Soil			Weak Soil			Standard Soil			Weak Soil		
	With Anchor Base ⁽²⁾	Direct Burial	With Anchor Base ⁽²⁾	Direct Burial	With Anchor Base ⁽²⁾	Direct Burial	With Anchor Base ⁽²⁾	Direct Burial	With Anchor Base ⁽²⁾	Direct Burial	With Anchor Base ⁽²⁾	Direct Burial
63.5x63.5 (2.5x2.5)	2.10 mm ⁽³⁾	2.66 mm ⁽³⁾	2.10 mm ⁽³⁾	2.66 mm ⁽³⁾	2.10 mm ⁽³⁾	2.66 mm ⁽³⁾	2.10 mm ⁽³⁾	2.66 mm ⁽³⁾	2.10 mm ⁽³⁾	2.66 mm ⁽³⁾	2.10 mm ⁽³⁾	2.66 mm ⁽³⁾
57.2x57.2 (2.25x2.25)*	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
50.8x50.8 (2.0x2.0)*	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
44.5x44.5 (1.75x1.75)*	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
38.1x38.1 (1.5x1.5)*	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes

1. 413.69 MPa = 60,000 psi. The ultimate tensile strength of the steel coil used to produce the tube should not exceed 550 MPa (79,800 psi) or have an elongation measured over 50 mm (2 inches) greater than 20%.
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